# Active detection for aerial survey

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mathieu.laroze@irisa.fr, romain.dambreville@irisa.fr, chloe.friguet@irisa.fr, ewa.kijak@irisa.fr, sebastien.lefevre@irisa.fr

## Motivations

Nowadays, remote sensing technologies greatly ease environmental assessment over large study areas using aerial images, e.g. for monitoring and counting animals or ships. Such data are most often analyzed manually by an operator, leading to costly and non scalable solutions.
Object detection algorithms are used to fasten and automate the counting processes. In the fields of both machine learning and image processing, many algorithms have been developed to tackle this complex challenge. The main common assumption to these algorithms is the need to have prior ground truth available. However, for field experts or engineers, manually labeling the objects requires a time-consuming and tedious process.
**Our goal is to develop an active learning framework to fasten small object detection in a hybrid human-machine learning approach.**

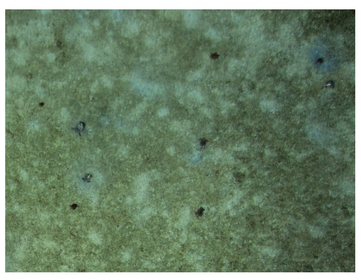
## Why An Interactive Framework ?

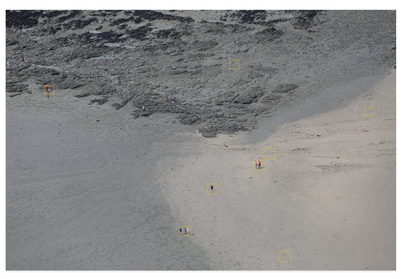
The increasing amount of data gathered for machine learning algorithms drives human-in-the-loop research nowadays. But within this field, user interactions are mainly designed to use efficiently human brain decision on simple labeling tasks for crowd-sourcing classification.
In this perspective, **the image information context is needed for experts** to efficiently use their experience in photo-interpretation, i.e. a marine biologist has specific knowledge on the possibility to distinguish hard examples based on the location or the form of the species.
Instead of asking the user to label uncertain instances with presentation of extracted samples, we aim to get feedback from the user about the next most informative image to be labeled. **By doing so, our process does not remove the usual labeling tasks but help optimizing them.**

## Application

The proposed framework will be tested with image datasets from different aerial surveys, in order to assess the algorithm generalization capability. Its performance will also be evaluated on the overall process in comparison with a fully supervised method.
Two sets are studied within Irisa and Wipsea, a wildlife image analysis company, collaboration and will be considered for the first experiments:

1. Turtle detection set
2. Seashell gatherer detection set





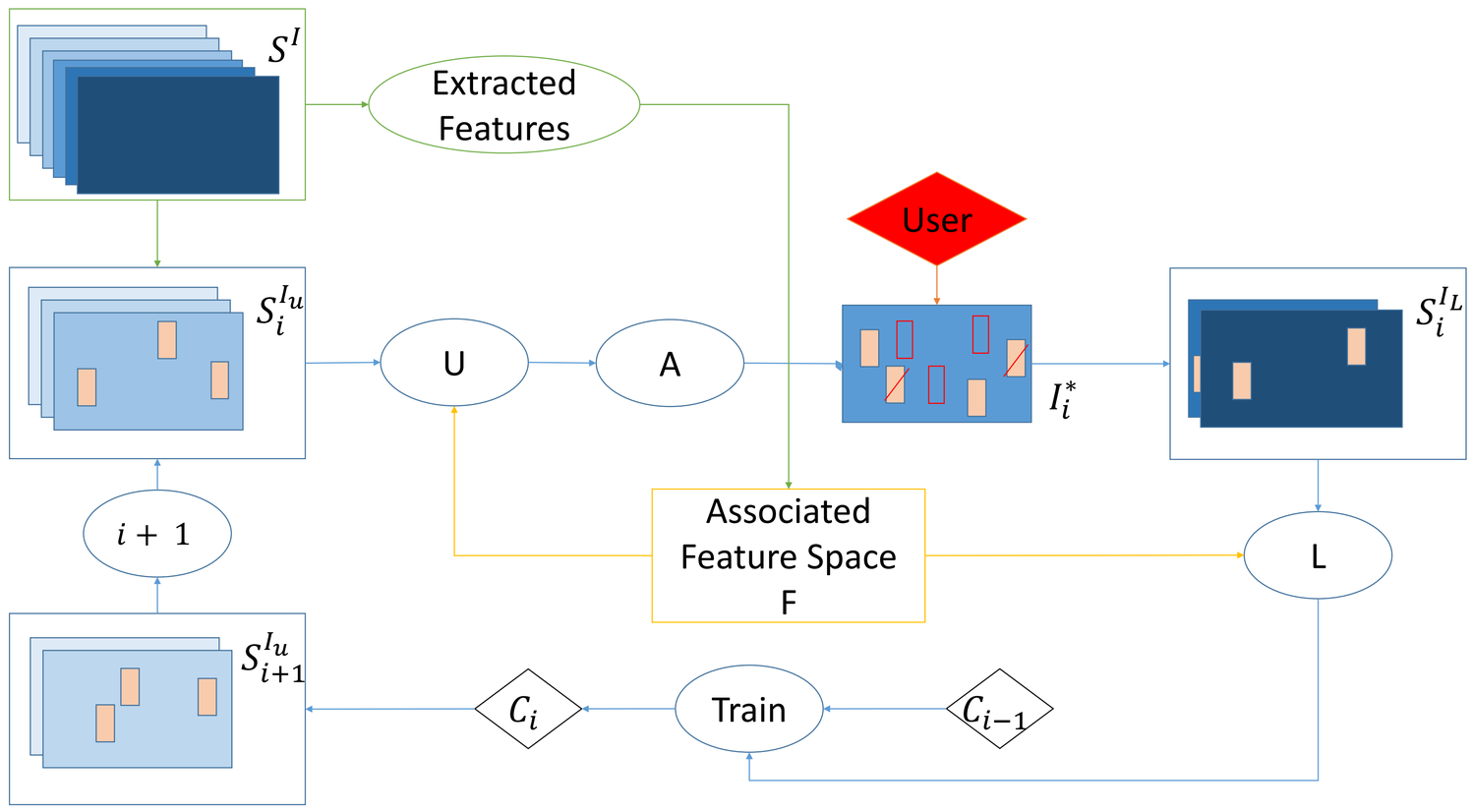
## Notations

- $S^I$: Complete image set
- $S^{I_U}$, $S^{I_L}$: Image set with Uncertain labels ($u$) and Labels ($L$) checked by the user
- A: Active process
- U, L: Unlabeled/Labeled feature space and image set update function
- $I^*$: Image queried by A to be labeled by the user
- $C$: Classifier

## Our Active Learning Solution

- The proposed method lies in the active learning paradigm. The Active Process A selects in the Unlabeled set $U$ the most informative data to be labeled by the user and added to the training set of Labeled data $L$ to improve the classifier performances.
- Our query strategy aims to **optimize the number of iterations under the constraint of querying** $I^*$ to the user.
- A specific metric is then needed to select the most informative image $I^*$ with a trade-off between an image with as much positive class instances as possible to be labeled in order to increase $L$ quickly and an image containing uncertain instances that would increase the precision of $C$.

## Proposed System Overview




## Conclusion

This approach will allow us to get an experimental framework to apply our active query by image and test it with experts. Image processing can be improved and fasten considering both localization and detection processes. Besides it allows us to study classifier performances regarding its incremental training dataset size. It is also possible to scale up with different user scenarios such as crowd-sourcing labeling.
Our approach could be extended to other area than image processing where labeling instances under group constraint is relevant.

UMR IRISA — UNIVERSITÉ DE RENNES 1 — Université Bretagne Sud — WIPSEA Wildlife Images Process